OPTICAL GLUCOSE SENSOR FOR SINGLE USE MICROFLUIDIC REACTORS

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Glucose measurements are of tremendous interest in biotechnology. Electrochemical and optical methods to measure glucose have been intensively investigated in the last 30 years, in particular for medical diagnostics. A widely used principle is to measure the consumption of oxygen during the oxidation process of glucose facilitated by the enzyme glucose oxidase. The determination of glucose is based on a correlation between the oxygen consumption and the glucose concentration.

In our contribution, we demonstrate the integration of a flow-through glucose sensor into microfluidic devices for cell culturing. The sensor consists of three layers: an oxygen sensitive layer, an enzymatic glucose-oxidase layer for glucose induced oxygen consumption and a diffusion layer. The oxygen sensitive layer contains polystyrene particles stained with meso-tetra(4-fluorophenyl)tetrabenzoporphyrin (PtTPTBPF4) embedded in a swellable hydrogel. The second layer contains aggregates of the enzyme glucose oxidase embedded in the same hydrogel. The last and final layer is a plain hydrogel diffusion barrier. By increasing the layer height of the diffusion layer, the dynamic range of the sensor can be tuned.

The sensor spots (3mm in size) were prepared by microdispensing onto polymer substrates, which are later assembled to microfluidic devices. The glucose concentration can be measured contactlessly from the outside of the channel by using an optical fiber of a miniaturized phase-fluorimeter.

We present results on the sensor characterization including response and calibration curves, height profiles individual layers and influence of flow velocity.

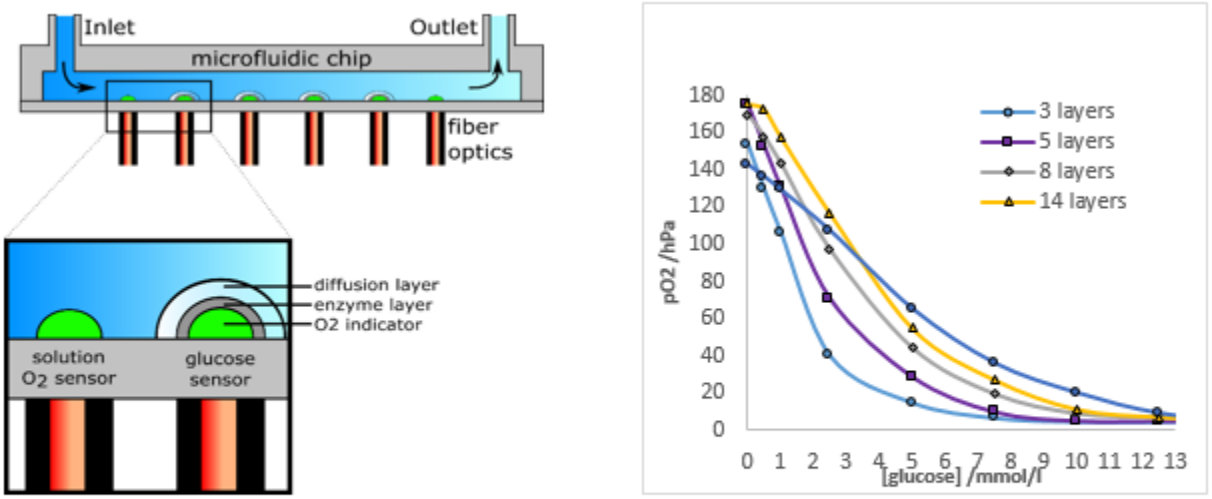

Figure: Schematic of the glucose sensor (left) and calibration curves of glucose sensors with varying diffussion layers to adjust the dynamic range.